Appl. No. : 09/855,321
Filed : May 14, 2001

SUMMARY OF INTERVIEW

Exhibits and/or Demonstrations

None.

Identification of Claims Discussed

All pending claims.

Identification of Prior Art Discussed

U.S. Patent No. 5,300,186 was discussed, along with the state of the art generally.

Proposed Amendments

None.

Principal Arguments and Other Matters

Applicants argued that 5,300,186 lacks the specific teachings necessary to anticipate the pending claims and that the Examiner's assertion that the claimed process is inherently disclosed is not supported by the teachings of the references. Applicants also submitted that the skilled artisan would have been motivated to minimize purge times and thus would not have modified any of the cited references to arrive at the claimed invention.

Results of Interview

Applicants agreed to file the present response including their arguments.

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REMARKS

Claims 17-21 and 23-45 are pending in this application and the Examiner has maintained the previous rejections. Applicants wish to thank the Examiner for the opportunity to discuss the Office Action in a telephone interview with the undersigned on May 23, 2006. The comments below are consistent with that discussion.

Claim Rejections

The pending claims stand rejected as anticipated by U.S. Patent No. 5,300,186 to Kitahara et al. ("Kitahara") and/or obvious in view of Kitahara alone or in combination with U.S. Patent No. 3,662,583 to Moore ("Moore"). While the Examiner admits that in Kitahara "the volume of the chamber is not explicitly taught," the Examiner concluded that Claims 17-21, 23-25 and 32-43 are anticipated because "the flow times explicitly taught read on moving multiple reaction space volumes of inactive gas through the reaction space for any reasonably sized reactor used for coating silicon wafers." Similarly, in response to Applicants' previous arguments the Examiner stated that "many references use relative flow times, wherein the purge flow time exceeds the reactant flow time by 2-10 times. This is also inclusive of 'at least two reactant space volumes." Applicants strongly disagree.

In order to anticipate the present claims, Kitihara (or any other reference) must teach each element of the claims either explicitly or inherently. Here, Kitahara does *not* teach an atomic layer deposition process comprising moving at least two reaction space volumes of inactive gas through a reaction space in an interval between each two successive vapor phase reactant pulses, as recited by Claim 17. Without a particular reaction space volume, it is not possible to conclude that Kitahara moves two reactant space volumes of inactive gas through the reaction space in the interval between reactant pulses. The relationship between reactant flow times and purge flow times provides no indication, in and of itself, of the reaction space volumes of gas moving through the reaction chamber.

The assertion that "many references" teach purge flow times exceeding reactant flow by 2-10 times also does not provide any teaching or suggestion of moving at least two reaction space volumes of gas through a reaction chamber between successive reactant pulses and *cannot* unless specifically combined with a teaching of both 1) purge flow rates and 2) a reaction chamber

volume. In other words, in order to meet the claims and establish a prima facie case of obviousness (much less anticipation), the Examiner needs to identify all three of 1) purge flow rates, 2) purge duration and 3) reaction space volume. The Examiner has identified no such teachings and has only identified the relative duration of reactant and purge pulses.

The Examiner concedes on page 4 of the Office Action that the anticipation rejection relies on inherency. As Applicants have previously pointed out, "Inherency, however, may not be established by probabilities or possibilities. The fact that a given thing *may* result from a given set of circumstances ***is not sufficient***." *In re* Oelrich, 212 U.S.P.Q. 2d 1597, 1599 (Fed. Cir. 2002), emphasis added. The Examiner's assertion that the ratio of purge flow times to reactant flow times would lead to moving at least two gas volumes through the reaction chamber between reactant pulses "for any reasonable sized reactor" clearly does not meet this standard for at least the reason there can be no certainty without knowing the purge flow rate and reaction space volume for a particular ALD process.

In addition, Kitahara has no teaching or suggestion of removing reactant molecules adsorbed on the walls of the reaction space, as also recited in Claims 17 and 41. The Examiner does not address this element, other than to say that "using the proper amount of gas to remove reactants from the reaction space, including the walls of the reactor (reactant on the walls are part of the reaction space), is inclusive of the purge step taught in the prior art." Thus, the Examiner is again relying on inherency. However, as discussed further below, there is no recognition in the art that any advantage would be gained by removing *adsorbed* reactant from the walls of the reactor. While it may be that the purge step disclosed in Kitahara is sufficient to remove excess *vapor phase* reactant from the reaction chamber, this would not *necessarily* (as is legally required under the law of inherency) remove reactant *adsorbed* on the walls of the reaction chamber. Thus, Kitahara does not inherently teach this element either.

The Examiner appears to recognize the limitations of the inherency rejections, stating that "In the event the applicant disagrees with the Examiners assessment of the flow rate inherently filling multiple reaction space volumes, it would have been obvious at the time the invention was made...to determine the volume of gas required to maximally remove the reactant gas and any residual component species." The Examiner supports this finding by stating that "one of

ordinary skill knows that the longer one purges, the more reactant may be removed. To optimize the purge time with the cost of purge gas would have been at least obvious."

First, there is no teaching or suggestion in Kitahara that their purge time had not been optimized or needs to be optimized further. The simple recognition that "the longer one purges, the more reactant may be removed" would not suggest to one of skill in the art that a process needs to be optimized unless there is some motivation to do so, such as a recognition that not enough reactant is being removed.

Further, without the recognition of a particular problem to be solved, optimizing the purge time with the cost of purge gas, as suggested by the Examiner would ***not*** result in the claimed invention. To the contrary, the skilled artisan would have ***minimized*** the volume of purge gas directed into the reaction space to the lowest level necessary to avoid vapor phase interactions between reactants. By ***minimizing*** purge time, there is a cost savings in both the amount of gas needed and, more importantly, in increasing throughput. There is no indication in the art that the skilled artisan would have arrived at the same balance, particularly since different criteria are employed in determining the sufficiency of the purge.

There is no teaching or suggestion in Kitahara that would lead the skilled artisan to optimize the purge time at all, much less to optimize the purge time to move at least two reaction space volumes of purge gas through the reaction space between reactant pulses. Kitahara did not recognize the problems associated with conventional ALD methods that the Applicants have addressed and thus would have applied different criteria in achieving the balance (e.g., optimized for removal of gas phase reactants rather than adsorbed reactants from the walls of the reactor. There is no motivation to modify Kitahara to arrive at the claimed amount of purging.

Applicants submit that because Kitahara did not recognize any problem associated with contamination from adsorbed reactant particles, or any problem that could be addressed by adjusting the purge step (rather than any other process step or condition), the skilled artisan, operating under the teachings of Kitahara and the general knowledge in the art and without the hindsight benefit of Applicants invention, would have no reason to optimize the purging time of Kitahara to arrive at the recited extent of purging. As a result, the rejection of Claims 17 and 41 should be withdrawn. In addition, as the remaining claims depend from Claim 17 or 41 and

contain all of the features thereof in addition to further distinguishing features, Applicants submit that all claims are in condition for allowance.

With respect to Claims 26-31, which were rejected over the combination of Kitahara and Moore, Applicants note that Moore does not make up for the deficiencies of Kitahara described above.

Finally, Applicants traverse the rejection of Claim 41 on the additional ground that Kitahara does not teach or suggest an atomic layer deposition process comprising in a first pulse flowing only an inactive gas directly into the reaction chamber through a second inflow channel ***while*** flowing a first vapor-phase reactant into the reaction chamber through a first inflow channel, and in a second pulse flowing only an inactive gas into the reaction chamber through the first inflow channel ***while*** flowing a second vapor-phase reactant into the reaction chamber through the second inflow channel, as claimed. Claim 41 recites this sequence in combination with "moving at least two reaction space volumes" between reactant pulses. Kitahara teaches alternately and sequentially feeding into a reaction chamber trimethyl aluminum (TMA), hydrogen (H_2), and arsine (AsH_3). *See* Kitahara, col. 4, lines 56-68 to col. 5, lines 1-4. In fact, in Fig. 3 of Kitahara, the H_2 pulse does <u>not</u> overlap with either the TMA pulse or the arsine pulse. This deficiency is not made up for by any secondary reference. Thus, Applicants respectfully request withdrawal of the rejection of Claim 41, and Claims 42-45 which depend therefrom.

CONCLUSIONS

In view of the foregoing remarks, Applicants respectfully submit that the present application is in condition for allowance and request the same. If, however, some issue remains that the Examiner feels can be addressed by Examiner's amendment, the Examiner is cordially invited to call the undersigned for authorization.

Appl. No. : **09/855,321**
Filed : **May 14, 2001**

Respectfully submitted,

KNOBBE, MARTENS, OLSON & BEAR, LLP

Dated: June 1, 2006

By: _____

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